second location and second branch discussed hereinabove with respect to the first embodiment.

The second embodiment uses passive means for allocating the bypass fuel flow between the first and third locations **58, 68** comprising one or more flow restrictors **72, 74, 76**, disposed respectively in the first branch **54**, the fuel inlet of the first fuel-oil heat exchanger **20**, and/or the third branch **70**. Based on differential pressures and fuel flow rates at different points in the various fuel lines, the flow restrictors **72, 74, 76** allocate not only the bypass fuel flowing in bypass line **52** between the first location **58** and the second location **68**, but may additionally allocate the flow of fresh fuel from the fuel tank **34** between the inlet of the first fuel-oil heat exchanger **20** and the second return location **68** as discussed hereinbelow.

During periods of low power or idle engine operation when the metered fuel flow rate is low, bypass fuel in the bypass line **52** flows into branches **54, 70** and is returned to the supply side of the main fuel pump **44** at return locations **58** and **68**. During such periods of operation, sufficient flow of recirculating bypass fuel is present through the first fuel-oil heat exchanger **20** to permit cooling of the fuel by the first oil loop **14** and the first air-oil cooler **18**. The exact distribution of the bypass fuel between the first and second locations **58, 68** are determined by the needs of the individual systems, and effected by sizing the flow restrictors **72, 74, 76** appropriately.

During periods of high engine power operation, such as while cruising or during takeoff, fresh fuel supplied from the fuel tank **34** is split at location **58** between the first fuel-oil heat exchanger **20** and the first branch **54**. The fresh unmixed fuel bypasses the exchangers **20, 28**, joining the bypass fuel in the third branch **70**, entering the main fuel pump supply at the third return location **68**. The flow restrictors **72, 74, 76** are again used to insure a proper distribution of fresh fuel between the fuel-oil heat exchangers **20, 28** and the first branch **54** according to the heat transfer needs of the joined loops. It should be noted that although the second embodiment is shown in FIG. 2 as utilizing fixed orifice type flow restrictors, it is within the scope of the present invention to utilize flow restrictors having different flow coefficients depending on the direction of the fuel flowing therethrough as well as active fuel flow diverter means such as flow control valves or the like.

Since the actual sizing and distribution of the recycle and fresh fuel between the first and third locations **58, 68** is dependent upon the heat transfer needs of the engine **10** and the accessory drive **12** over the entire engine and drive operating envelope, no specific restrictor sizes or flow proportions are disclosed herein. Such parameters would be developed for each individual engine application based on test results, predicted heat generation rates, required operating environments, and the specifications of the individual engine manufacturer.

The second embodiment according to the present invention thus reduces the proportional range of fuel flow rate in both the first fuel-oil heat exchanger **20** and the second fuel-oil heat exchanger **28** by diverting a portion of the fresh fuel from the tank **34** through the first branch **54** and third branch **70**. The use of flow restrictors **72, 74, 76** to effect the reversing flow **73** in the first branch **54** provides a passive means for allocating the flow of both fresh and bypass fuel between the first and third return locations **58, 68** over the range of engine operation.

As discussed above with respect to the first embodiment, the higher metered fuel flow rate present at normal engine power levels is more than sufficient to cool the accessory drive **12** and the engine **10** without the need for diverting cooling air **22, 30** from the engine fan or compressor sections and thereby avoiding any loss of efficiency resulting therefrom. It will be appreciated, however, that the cooling air regulating valves **24, 32** may be controlled responsive to the fuel and/or oil temperatures in the respective loops **14, 16** as necessary to optimize system performance over the entire range of engine operation.

The present invention thus provides a heat management system for benefically distributing fuel in the fuel supply system of a gas turbine engine among various locations with respect to first and second fuel-oil heat exchangers disposed in a heat transfer relationship with the fresh and bypass fuel streams for the purpose of maximizing the internal heat transfer between the circulating cooling oil and the fuel. The foregoing discussion, while attempting to disclose the invention in broad terms commensurate with the scope thereof, nonetheless has been directed to an explanation of only two embodiments thereof and should therefore not be interpreted as limiting, but rather as an illustration of what applicants believe is the best mode for carrying out the invention.

We claim:

1. A system for transferring heat energy among a heat generating gas turbine engine, a heat generating accessory drive coupled to the gas turbine engine, a stream of fuel flowing at a metered flow rate, and a stream of cooling air, comprising:

a first oil circulation loop wherein a first flow of oil circulates through the accessory drive, a first air-oil cooler having a first, regulated portion of the cooling air stream also passing therethrough, and a first fuel-oil heat exchanger;

a second oil circulation loop wherein a second flow of oil circulates through the gas turbine engine, a second air-oil cooler having a second, regulated portion of the cooling air stream also passing therethrough, and a second fuel-oil heat exchanger;

means for conducting at least a portion of the metered fuel stream, in sequence, through the first fuel-oil heat exchanger, the second fuel-oil heat exchanger, and a main fuel pump, the main fuel pump operating at a fuel delivery rate in excess of the metered fuel flow rate;

a fuel controller for receiving the fuel flowing from the main fuel pump and dividing the received fuel between a supply stream having a flow rate equal to the metered flow rate, and a bypass stream having a flow rate equal to the excess of the main pump delivery rate over the metered flow rate; and

means, in fluid communication with the fuel controller and the conducting means, for returning the bypass fuel stream into the fuel conducting means upstream of the main fuel pump at a plurality of distinct locations.

2. The system for transferring heat energy as recited in claim **1**, further comprising

means, responsive to an operating parameter of the gas turbine engine, for apportioning the bypass flow stream among each of the distinct locations in the fuel conducting means.